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Requestor — Document Center (Is requested to provide the following document)

Date of request ~~12/12/95~~ 2/16/96 — Expected receipt of document ~~3/16/96~~

Document number ~~KP-1993~~ K/EM-379 — Date of document 7/7/60

Title and author (if document is unnumbered)

(This section to be completed by Document Center)

Date request received 2/20/96

Date submitted to ADC 2/21/96

Date submitted to HSA Coordinator 2/20/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 2/21/96 3/13/96 3/19/9

Date received from CICO 2/21/96 3/19/96

Date submitted to ChemRisk/Shonka and DOE 3/25/96

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received

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K/EM-379

SANITIZED VERSION OF OPERATING COST STUDY OF OAK RIDGE-PADUCAH FEED PLANTS (JULY 7, 1960)

(SANITIZED VERSION OF CRD DOCUMENT # KP-1993)

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

March 13, 1996

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the U.S. DEPARTMENT OF ENERGY
under Contract DE-AC05-84OR21400

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This doc[redacted]t consists[redacted]f 6 pages,
No.[redacted] of 10 [redacted]es, Series A

[redacted]

Date of Issue: July 7, 1960

KP 1993 10 A [redacted]

KP 1993 10 A

L-63804

OPERATING COST STUDY OF OAK RIDGE - PADUCAH FEED PLANTS

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OAK RIDGE GASEOUS DIFFUSION PLANT

UNION CARBIDE NUCLEAR COMPANY

SRD classification [redacted] CRD
[redacted] 9/[redacted]/94
ADD signature [redacted] Date

[redacted] downgrading [redacted] DD [redacted] by DO[redacted] of Declassi[redacted] 6/16/94.

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OPERATING COST STUDY OF OAK RIDGE - PADUCAH FEED PLANTS

Reductions in UO_3 deliveries to the UCNC Feed Plants have been recently proposed for the first and second quarters of FY 1961. A study was initiated to evaluate the most economical level of operation at the Oak Ridge - Paducah feed production facilities during this period. Oxide availability for the three cases considered in this study are based on the ORO consolidated feed schedule, ORO-106149, dated May 26, 1960. Estimated costs of operation for three alternate methods of operation are presented in the attached table.

Basic assumptions and explanations are summarized below:

CASE I

1. The Oak Ridge Feed Plant would process only Hanford enriched oxide (235 TU). This oxide would be campaigned and converted to UF_4 by the screw hydrofluorination reactors at a rate of 11 TU/day. The UF_4 would then be fluorinated in the cleanup reactors at a rate of 1.28 TU/day to utilize the cascade vent gases on a continuous 21 shift per week basis. The remaining 8720 TU of scheduled oxide would be processed at the Paducah feed plant at an average rate of 47.39 TU/day. The Oak Ridge and Paducah feed plants would resume operations at 11 and 43.5 TU/day rates January 1, 1961.

2. Ten large fluorine cells would be operated on the germanium rectifier system on a continuous 21 shift per week basis to produce an average of 1050 pounds of fluorine per day

3. Processing costs at ORGDP were estimated at $1708/TU at the reduced production rate of 1.28 TU/day. This high unit cost reflects the high fixed costs for maintenance labor and material and worked materials based on the following assumptions:

   a) The feed and fluorine production facility must be adequately maintained during the period of low production so that production at the 11 TU/day rate could be resumed after the six-month period. For example, from past experience it was assumed that the majority of cells "frozen down" during the period of low level production would require rebuilding when normal operations were resumed. Cost of maintaining the HF storage, vaporization and condensing system and the refrigeration system would not be significantly reduced by the reduction in production since these entire systems would continue in service.

   b) Reduction in feed plant usage of worked materials such as steam, air, water, and Process Engineering services during this six-month period would not significantly reduce the total plant operating costs. Therefore, worked materials costs other than power

were assumed to be the same as at the 11 TU/day rate. The current unit cost basis was used in calculating power costs.

c) Raw material costs such as HF were based on the current usage rate per pound of product.

4. Processing costs for the 8720 TU at Paducah were assumed to be $428/TU. This cost was derived from the Paducah Budget Estimates, KYC-332, Vol. II. This estimated reported $434/TU for 43.5 TU/day (8004 T) and $360/TU above 43.5 TU (716 T).

5. It was assumed that cost penalties totaling $92,783 would be experienced at ORGDP in addition to the cost of processing Hanford enriched oxide at the reduced rate. An analysis of these penalties are as follows:

a) Penalty for manpower utilization $ 11,149

During the period of low production, operator requirements would be reduced by 16 men. Since these men would be required when normal operations were resumed in six months, it was assumed that these men would not be terminated but would be paid at the operator's rate of $2.94/hr. during the six-month period although they would be utilized in a classification of lower pay of $2.27/hr. or a net penalty difference of $0.67/hr.

Since their reassignment is primarily a method for maintaining a working force for the later resumption of larger-scale operation (rather than any substantial manpower need in the groups to which they are reassigned), it is doubtful that the men involved could be utilized at a level of effectiveness much greater than fifty per cent. This penalty has not been included in the cost balance; however, it would approach $25,000 in a six-month period.

b) Fluorine cost increase for other users - $ 60,278

During the six-month period an increase in fluorine unit cost would be experienced as a result of reduced production and the high fixed maintenance costs associated with the standby operation for the entire fluorine plant. The increase of $0.364/lb. between the cost of fluorine produced at the 11 TU/day and the 1.28 TU/day rates would be paid by the cascade and other users of fluorine.

c) Increase in transportation cost - $ 21,356

The Savannah River oxide which is normally processed at Oak Ridge would be shipped to Paducah for processing. A cost penalty totaling $9240 at the rate of $14/TU was assumed for the increase in transportation charges between SRO-Oak Ridge and SRO-Paducah.

To compensate for the reduced feed production at ORGDP and maintain the proper GAT-ORGDP feed split, the Paducah to Oak Ridge UF_6 shipments would be increased 3.05 TU/day at a cost of $12,116 for the six-month period.

CASE II

1. The Oak Ridge feed plant would operate continuously for the first and second quarters of FY 1961 at a 11 TU/day rate (2024 TU total). During this period, the Paducah feed plant would operate at a reduced rate of 37.67 TU/day (6931 TU total). The Paducah feed plant would resume operations at a rate of 43.5 TU/day January 1, 1961.

2. Processing costs at Oak Ridge were assumed to be $546/TU, and were based on current budget assumptions as outlined in KAD-411, ORGDP Budget Estimates - Operations, April 22, 1960.

3. Paducah processing costs at the 37.67 TU/day rate were estimated at $445 per TU. This cost was based on current budget estimates as outlined in KYC-332 for a 43.5 TU/day rate with adjustments using a decremental cost of $360/TU for each ton processed under the 43.5-ton rate. The decremental cost was also based on budget estimates as outlined in KYC-332.

CASE III

In this case feed production at Oak Ridge would be curtailed insofar as possible in the following manner:

1. The Oak Ridge feed plant would process the Hanford enriched oxide (235 TU) on a campaigned basis in the following manner:

   a) The remainder of the June receipts (70 TU) would be processed to UF_6 in July.

   b) The feed manufacturing process would be shut down from July 8 to December 15.

   c) The September (94 TU) and October (47 TU) receipts would be stockpiled until December 15 and processed to UF_6 at 11 TU/day rate with the 94 TU December receipts.

2. During the period from July 8 to December 15, six or eight fluorine cells would be operated with semi-automatic controls to supply fluorine Such an operation is described in KP-1948, "Five Cell Semi-Automatic Fluorine Plant," April 26, 1960. A capital expenditure of approximately $15,000 would be required to modify the present fluorine plant for semi-automatic operation. In addition, it would be necessary to maintain the entire fluorine plant to permit resumption of larger-scale production at the end of the period.

3. Disposal of fluorine from the cascade vent would be accomplished in a potassium hydroxide scrubbing tower which could be located in the K-311-1 area where operator coverage is available. An expenditure of approximately $25,000 would be required for the design and installation of the scrubber.

4. The Oak Ridge and Paducah feed plants would resume operations at 11 and 43.5 TU/day January 1, 1961.

SUMMARY

A comparison of total UCNC costs for the methods of operation presented in Cases I and II is shown in the attached table. This comparison indicates a total net savings of $36,848 could be realized by adopting Case II for the first and second quarters of FY 1961. The potential uncertainty in these estimates is large enough that, perhaps, the only valid conclusion that can be reached is the fact that no tangible economic difference can be found between the two methods of operation.

Case III does not warrant serious consideration as a method of operation in a period as short as the next six months for the following reasons:

1. A period of at least three months would be required to install instrumentation required for semi-automatic operation of the fluorine plant. Additional time would certainly be required for "de-bugging" this type of operation.

2. Design and installation of the vent gas scrubber would require approximately three months. Until the scrubber was completed the vent gas would have to be reacted in the cleanup reactor as in Case I. After the scrubber is installed, its cost of operation (including the value of the fluorine which must be scrubbed from the purge gases) would be at least $250 per day.

The study of Case III does indicate that the capital expenditure required for semi-automatic operation of the fluorine plant would be economically justified if the ORGDP feed plant is shut down for extended periods. While the use of the vent scrubber represents a wasteful loss of valuable fluorine, it appears to be the only reliable means for fluorine disposal which is available at this time.

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PRELIMINARY ENGINEERING ESTIMATE OF UCNC FEED PLANT COSTS

First and Second Quarters Fiscal Year 1961

	CASE I	CASE II
FEED PRODUCTION COSTS		
Oak Ridge		
Production Rate	1.28 T/day (235T)	11 T/day (2024 T)
Unit Cost ($/TU)	1708	546
Total Cost	$ 401,304	$ 1,105,104
Paducah		
Production Rate	47.39 T/day (8720T)	37.67 T/day (6931)
Unit Cost ($/TU)	428	445
(8004 T at $434)		43.50 at 434 = 18,879
(716 T at $360)		- 5.83 at 360 = 2,099
		37.67 at 445 = 16,780
Total Cost	$ 3,732,160	$ 3,084,295
Oak Ridge plus Paducah Feed Production	$ 4,133,464	$ 4,189,399
PENALTY FOR MANPOWER UTILIZATION		
$0.67/hr. penalty for 16 men (16 x 40 x 26 x .67)	$ 11,149	None
FLUORINE COST INCREASE FOR OTHERS		
(900 x 184 x .364)	$ 60,278	None
TRANSPORTATION		
UO_3 SRO to Paducah: 600 T at $14/T = $ 9,240	$ 21,356	
UF_6 Paducah to Oak Ridge: 3.05 x 184 x 21.59 = $ 12,116		
Total UCNC Cost	$ 4,226,247	$ 4,189,399
Net Difference in favor of Case II		$ 36,848

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DISTRIBUTION

1. K-25 Site Records (RC)
2. ChemRisk/Shonka Research Associates
3. S. G. Thornton (K-25 EMD)
4. DOE Public Reading Room